

## REMARKS

Claims 11, 13-22, 24-28, 34-45, 47-50, 52-61, and 63-65 are pending. Claims 1-10, 12, 23, 29-33, 46, 51, and 62 have been withdrawn. Independent claims 11 and 40 are amended with the support of at least the abstract and paragraphs [0008], [0029], [0036], and [0089] of the specification. Dependent claims 14-16, 18-19, 21, 29-30, 40, 43-44, 46-47, 49, and 55-57 are amended for consistency with the amendments to claims 11 and 40. Claim 14 is also amended to recite an "actual signal" as described in the specification in paragraph [0089] instead of a "subject signal." Claims 66 and 67 are new and are supported at least by the abstract and paragraphs [0029], [0036], and [0089] of the specification. No new matter has been added by way of amendment.

### Interview Summary

Applicants gratefully acknowledge the time of Examiner Shahrestani and Examiner Casler to conduct an interview at the USPTO with Professor Gary Eden, co-inventor of the claimed subject matter, and Mindy N. Rittner, the undersigned agent for Applicants, on February 10, 2011. Differences between the disclosure of U.S. Patent Application Publication 2004/0027928 ("Awano") and the invention recited in independent claims 11 and 40 were discussed. The amendments to claims 11 and 40 presented herein have been made for clarity and were formulated in collaboration with Examiners Shahrestani and Casler during the interview. The Examiners were in agreement that claims 11 and 40, at least as amended herein, distinguish over the disclosure of Awano.

### Rejections of the Claims Under 35 U.S.C. §102

Claims 11, 13, and 40 stand rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent Application Publication 2004/0027928 ("Awano"). Applicants respectfully disagree, at least in view of the present amendments to independent claims 11 and 40.

Independent Claim 11

As amended, independent claim 11 recites a detection apparatus to detect weak magnetic fields comprising: a first magneto-optical element that exhibits a response, in the form of Faraday rotation, to an applied magnetic field, a hysteresis characteristic of the Faraday rotation exhibiting transition regions between a plurality of stable states; a light source to emit light that impinges on the first magneto-optical element; a modulation element comprising a coil adjacent to the first magneto-optical element, the modulation element being a source of a time-varying magnetic field of sufficient strength to switch the first magneto-optical element between the stable states; and a detector configured to detect a change in the light caused by a reaction of the first magneto-optical element to a weak magnetic field, the change occurring when the first magneto-optical element is in one of the transition regions, and the detection apparatus having a sensitivity sufficient to detect the weak magnetic field.

*Awano does not teach or suggest a detector configured to detect a change in the light caused by a reaction of the first magneto-optical element to a weak magnetic field, where the change occurs when the first magneto-optical element is in one of the transition regions. Nor does the reference disclose a detection apparatus that has a sensitivity sufficient to detect the weak magnetic field. To the contrary, Awano's magneto-optical recording medium is not configured for magnetic field detection. Nor is there any teaching or suggestion of operating Awano's recording medium in the claimed transition regions. Without these features, a magneto-optical detection apparatus is not capable of detecting the weak magnetic fields as claimed.*

Instead, Awano teaches detection of light beams reflected from a magneto-optical recording medium to determine the magnetization state of the magnetic layers; the reference utilizes *only* stable magnetization states and there is no detection of a magnetic field involved. As described in paragraph [0025] of Awano, "FIG. 3(a) illustrates states of magnetization in first and second magnetic layers (recording layers) subjected to recording in accordance with Embodiment A4...Four combinations of states of magnetization exist on the magneto-optical recording medium...As for information

recorded on the basis of the four combinations of states of magnetization, the magneto-optical recording medium is irradiated with reproducing light beams at  $\lambda_1 = 443$  nm and  $\lambda_2 = 780$  nm to obtain reflected light beams therefrom so that the magnitudes of apparent Kerr rotation angles are determined as reproduced signals."

Lacking any disclosure whatsoever of a detector configured as recited by claim 11 to provide a sensitivity sufficient to detect weak magnetic fields, Awano fails to disclose each and every feature of the claimed invention. Accordingly, claim 11 and each claim depending therefrom are patentable over Awano.

#### Independent Claim 40

Amended independent claim 40 recites a method of detecting weak magnetic fields that includes providing a first magneto-optical element exhibiting a response, in the form of Faraday rotation, to an applied magnetic field, a hysteresis characteristic of the Faraday rotation exhibiting transition regions between stable states, wherein the first magneto-optical element is in the presence of a weak magnetic field; impinging light from a light source on the first magneto-optical element; applying a time-varying magnetic field from a modulation element to the first magneto-optical element; switching the first magneto-optical element between the stable states; and detecting a change in the light caused by a reaction of the first magneto-optical element to the weak magnetic field, the change occurring when the first magneto-optical element is in one of the transition regions.

As explained above, Awano is not interested in magnetic field detection or in exploiting the transition regions between stable states. The reference fails to teach or suggest detecting a change in the light caused by a reaction of the first magneto-optical element to the weak magnetic field, where the change occurs when the first magneto-optical element is in one of the transition regions, as required by claim 40. Indeed, Awano's method, which is directed entirely to recording and reproducing *stable magnetization states* on a magnetic recording medium, has *no capacity to respond to*

*weak magnetic fields*, as required by claim 40, since the transition regions between stable states are *not utilized*.

In view of these shortcomings, Applicants submit that Awano does not teach or suggest each and every feature of independent claim 40.

In summary, Applicants have amended independent claims 11 and 40 for clarity and have pointed out, both during the interview on February 10 and in the present response, the differences between the claimed invention and the cited reference. Examiner Shahrestani is therefore respectfully requested to withdraw the rejection of claims 11, 13 and 40 under 35 U.S.C. §102(e) over Awano.

### **Rejections of the Claims Under 35 U.S.C. §103**

Claims 14-21, 25-28, 34-39, 41-45, 47-49, 52, 53, and 59-64 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Awano in view of U.S. Patent 7,075,055 ("Nagai"). Claims 22, 24, and 50 are rejected under 35 U.S.C. §103(a) as being unpatentable over Awano in view of U.S. Patent Application Publication 2002/0149832 ("Matsushita"). Claims 54-58 stand rejected under 35 U.S.C. 103(a) over Awano and further in view of U.S. Patent Application Publication 2002/0173714 (Tsukada).

Applicants respectfully disagree. Claims 14-21, 25-28, and 34-39 depend from claim 11, and claims 41-45, 47-49, 52, 53, and 59-64 depend from claim 40. Applicants point out that claim 65, which depends from claim 40, is not included in the rejection.

As explained above, Awano fails to teach or suggest each and every feature of independent claims 11 and 40, and none of the supporting references (Nagai, Matsushita, and Tsukada) cited by Examiner Shahrestani remedies the deficiencies of Awano. Applicants explained the shortcomings of Nagai in detail in the Response dated July 9, 2010, and thus those arguments are not repeated here. Matsushita discloses a Faraday rotator for use in an optical measurement or recording system; the reference fails to teach or suggest a detector configured to detect a change in the light caused by a reaction of the first magneto-optical element to a weak magnetic field, where the change

occurs when the first magneto-optical element is in one of the claimed transition regions and where the detection apparatus has a sensitivity sufficient to detect the weak magnetic field, as recited by claim 11. Matshushita also fails to disclose a method that includes detecting a change in the light caused by a reaction of the first magneto-optical element to a weak magnetic field, where the change occurs when the first magneto-optical element is in one of the claimed transition regions, as recited by claim 40. Tsukada, which is directed toward a superconducting quantum interference device (SQUID) for detecting biomagnetic fields, also fails to disclose these features of the claimed invention.

Taken alone or in combination, the references cited by the Examiner fail to teach or suggest each and every feature of independent claims 11 and 40. Accordingly, a *prima facie* case of obviousness cannot be established with respect to these claims or any claims depending therefrom. Applicants therefore respectfully request that the Examiner withdraw the rejection of claims 14-21, 25-28, 34-39, 41-45, 47-49, 52, 53, and 59-64 under 35 U.S.C. §103(a).

### **Patentability of New Claims**

New claims 66 and 67 depend from independent claim 11 and independent claim 40, respectively. Both claims recite that the weak magnetic field is less than 100 pT. Due at least to their dependence on claims 11 and 40, which are patentable over the cited art for the reasons provided above, Applicants respectfully submit that new claims 66 and 67 are patentable over the prior art of record in this application. Accordingly, Examiner Shahrestani is respectfully requested to allow these claims.

## Summary

Applicants respectfully submit that the pending claims are in condition for allowance. Examiner Shahrestani is invited to contact the undersigned agent for the Applicant via telephone if such communication would expedite allowance of this application.

Respectfully submitted,

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